Developing Pure Cartoon for Stoichiometry Concept Combined with Guided Inquiry to Improve Process Skill and Students' Learning Outcome

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Abstract: This research aims at improving processing skills and learning outcome of students on stoichiometry concept. First stage was instructional instrument development, the second stage was trials on X graders of Senior High School using One Group Pre-test and Post-test Design. The results of this research showed that (1) the developed instructional instrument is good and reliable, (2) the lesson plan was well-accomplished, (3) students activity were positive during the learning, (4) students response were positive, (5) the cognitive learning iutcomes of product and process have met minimum criteria of mastery learning, (6) the improvement of processing skill is in the category of high gain. To sum up, the developed instructional instrument could improve students processing skill and learning outcomes.

Keyword: pure cartoon, guided inquiry, process skill, learning outcomes

Abstrak: Penelitian ini bertujuan meningkatkan keterampilan proses dan hasil belajar siswa pada konsep stoikiometri. Tahap pertama adalah pengembangan perangkat pembelajaran, tahap kedua adalah ujicoba pada siswa kelas X SMA menggunakan One Group Pre-test and Post-test Design. Hasil penelitian menunjukkan : 1. perangkat pembelajaran berkategori baik dan reliabel, 2. RPP dapat terlaksana dengan baik, 3. aktivitas siswa sangat positif dalam pembelajaran, 4. respon siswa terhadap pembelajaran sangat positif, 5. hasil belajar kognitif produk dan proses menunjukkan ketuntasan KKM; 6. peningkatan keterampilan proses berada pada kategori high gain. Hasil penelitian menunjukkan bahwa media yang dikembangkan dapat meningkatkan keterampilan proses dan hasil belajar siswa.

Kata kunci: pure cartoon, inkuiri terbimbing, keterampilan proses, hasil belajar

Globalization era is an era in which the development of science and technology occurs exponentially. It demands that every single entity in any aspect could improve and enhance the required competences. This will only be achived through education. Improvement on education sector is an essential matter to establish qualified nation's characters and culture. In addition, it is important to develop qualified young generation who possesses important qualifications such as intellectually brilliant, civilized, and able to collaborate and compete. Therefore, it is important to administer educational setting with mature plan and program to obtain maximum benefits.

Teacher takes a role as a facilitator to deliver and convey a message within learning and lesson. Teacher is often assisted by instructional media and model to generate effective learning process. Chemistry is one of lesson which consists of complicated ideas and it requires advanced skill of teaching during the process of learning. Within Chemistry, Stoichiometry is one of Chemistry topic which consists of abstract concept, some complicated equation of reaction and calculation. The use of appropriate media and learning models in the learning process will increase student activity, student learning motivation, and ultimately can improve student learning outcomes. But, in fact, the result of student's learning in Chemistry is still low.

According to the observation results on Pertiwi High School in Ambon Academic Year 2014/2015, only 44% of students have passed the minimum criteria of mastery learning (KKM 70). It is presumably due to the limited creativity of teacher in employing learning method and model during the learning process which made students did not want to engage in active learning. Teachers tended to employ

lecturing method of learning and at the end of the day, students remained passive. Students only obtained information from teacher. In addition, to explain a complicated and abstract concept, teacher did not employ instructional media. This made students feel bored and have limited interest in attending the lesson. At the end of the learning, students learning outcome will be beyond expectation.

It is important to develop instructional media and model which focuses on students (based on constructivist) and able to encourage students to develop their own knowledge through scientific inquiry, and encourage their processing skill. Teaching the processing skill is one of the learning process which is directed to certain ability of students. It encourages students ability to process the obtained information which make them able to reveal new things such as beneficial facts, concepts, or value and behavior development. Thorugh the processing skill, the obtained knowledge will be meaningful and students will have a developed pattern of thinking.

Pure cartoon media combined with guided inquiry learning model can be applied during the learning to improve processing skill of students and the learning outcomes. Pure cartoon media is a graphic media which functions as a media to explain the material and deliver better understanding of certain material. During the implementation, students will be given a formula or a theory with a mummies cartoon images prepared by teacher to assist them in asnwering questions within a group discussion or learning activity.

Guided inquiry learning model can be used to teach processing skill (high-order thinking skill) (Zawadzki, 2010). It is also in line with Brickman, et al (2009) argument which state that inquiry learning model can improve scientifical processing skill of students. Kristanto and Susilo (2015) also have similar opinion, students will have better learning outcome of science when they are being taught by guided inquiri learning model.

Guided Inquiry Learning Model

Joice (in Trianto, 2007) defines the learning model as a plan or pattern used as a guide in planning classroom lessons or tutorials learning and for determining instructional instruent including books, films, computers, etc.

According to Suprijono (2010), the learning model is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve specific learning goals and serves as a guide for teachers in planning learning activities.

Instructional media

The word media comes from the Latin word "Medius" which means middle, intermediary or introductory. According to Danim (2008), the media is a "tool" to provide stimulation for students to make the learning process and effective learning. Instructional media was developed as a result of a communications revolution that serves as an instrument other than teachers, textbooks, and whiteboards. Media is anything that can be used to deliver messages from message senders to message recipients so as to stimulate students' thoughts, feelings, concerns and interests so that the learning process occurs (Sadiman, 2007).

Media serves to overcome the limitations of student experience, the limitations of space which is possible to encourage direct interaction between the students and environment, generate similar observations, embed the basic concepts correctly, embed the concept of abstract to be concrete and realistic, and increase student motivation. Media consists of various types of small and large media, printed and virtual media, audio, visual, audiovisual, video, film frame and film (Tambunan & Simanjuntak, 2010). Each media has its own disadvantages and advantages. Good media is the medium that can convey the message well.

Pure Cartoon Media

Cartooncomes from the Italian word "cartone" which means paper. Cartoons are paintings of daily events that are described in a fun or interesting way. Cartoon is one form of graphic communication, which is an interpretative image that uses symbols to convey a message quickly and concisely (Sadiman, 2007). Cartoons usually only reveal the essence of the message to be delivered and illustrated it into a simple image, without detail by using symbols and characters that are easily recognizable and understood. According to Sudjana & Rivai (2010), cartoons are portrayals in the form of paintings or caricatures of people, ideas or situations designed to influence public opinion.

Processing Skill

Scientific processing skills in science learning are the skills learnt by students when they conduct scientific inquiry. They use a variety of processing skills, not just a single scientific method. These processing skills are the formulation of hypotheses,

controlling variables, conducting experiments, classifying, referencing, forecasting, communicating, measuring, using numbers, interpreting data, defining operationally, and formulating models (Nur, 2011).

Learning Outcomes

Learning outcomes are the result of desired student behavior that actually occurs after a subject is being taught. Learning outcomes should be observable and measurable. In addition, the learning objectives should be expressed as learning outcomes. According to Bloom, the form of behavior as a goal that must be formulated and can be classified into three domains, namely the cognitive, affective, and psychomotor domains (Sanjaya, 2011). Each domain is subdivided into more detailed divisions based on its hierarchy, i.e (a) the cognitive domain: Knowledge, understanding, application, analysis, synthesis, and evaluation; (b) affective domain; and (c) the psychomotor domain.

Assessment of learning outcomes in the cognitive domain both at the level of educational units and in colleges has been based on Bloom's taxonomy, but in its development this taxonomy has been revised by experts. The results of revisions in the cognitive domain are: remembering, understanding, applying, analyzing, evaluating, and creating.

Based on the above description, it is necessary to conduct research to develop pure cartoon instructional media for stoichiometry concept combined with guided inquiry learning model to improve students' processing skills and learning outcomes.

METHOD

This research was Research & Development which consists of two stages, namely the stage of instrument development and trials stage. Before the development of the media, firstly, it should develop instructional instruent. It was done because to develop a qualified instructional media, it should take into account factors that might create an influence such as desired learning outcomes, material characteristics, and students. This development employed Dick and Carey development model.

One Group Pretest-Posttest with O1 X O2 pattern was employed as an approach to test the instructional instruent. Where O1 = initial testing (pretest), X= treatment, and O2= final testing (posttest). This research was conducted at Pertiwi High School Ambon on X1 Grade for trial I and X2 Grade for trial II.

The research instruments were Student Activity Sheet , Learning Outcome Test, Pure cartoon media, validation sheet of instructional media and instrument, observation sheet of lesson plan implementation, student activity observation sheet, and student response sheet to the media and the whole learning process. The research data was analyzed descriptively.

RESULTS

Results of Trial I

Instructional Instrument Quality

The instructional instrument developed were then examined and validated by two lecturers. The results of validation were in the form of validation score, correction, and suggestions. Further, the suggestions obtained from the validators were used for revising and improving the instrument. The validation of Lesson Plan is presented in the following Table 1. Generally, the developed instruments have met the quality standard as shown in Table 1. Thus, it can be applied during the learning after being revised and improved based on validators suggestions.

Table 1. Instrument Validity Score

No	Instrument	Validation Result	Reliability (%)
1	Lesson Plan	Good	92.85
2	Students Activity Sheet	Good	84.61
3	Learning Outcomes Test	Good	85.23

The Results of Instructional Instrument Application

Assessment of the implementation of learning has been done well and was in good category. In general, student activity on trial I indicated that during learning was centered on students by applying the developed instructional instrument . Based on observations, the most dominant student activity was planning, conducting experimenting and observing.

Students responded very positively to the application of learning by using guided inquiry

model with pure cartoon media. These responses include the topics being studied, Student Activity Sheet, instructional models, instructional media, the way teachers teach and the learning atmosphere of the teacher trained; they responded well to the component; very interested in following teaching and learning activities; students felt that it is not difficult to answer the test of learning outcomes.

Students learning outcomes results on trial I which include cognitive learning outcome product and process through classical pretest was on unaccomplished category. After being treated by having pure cartoon media combined with guided inquiry model, students learning outcome in posttest accomplished.

According to the above-mentioned explanation, it can be concluded that the developed instructional instrument can be used for trial II. However, it required a revisions based on validators' suggestions.

Trial II Results

This trial involved X2 Grade of Pertiwi High School Ambon. The results exposed the observation of learning accomplishment, students activity, students' responses questionnaire, learning outcomes, and processing skill improvement.

Learning Accomplishment based on Guided Inquiry

Table 2. Lesson Plan Accomplishment

No	R1	R2	R3	AVERAGE R
	95	90	100	95
Accomplishment				100%

From the table above it can be seen that the average score for all activities observed in the learning is in good category with the percentage of implementation of lesson plan was 100%. The implementation of lessonj plan at each meeting was rated almost identically by observers. In the calculation of the successive reliability of the first meeting until the third meeting was 95%, 90%, and 100% so the average reliability of the instrument was 95%. Based on the data, it can be said that the instrument used was reliable because the reliability coefficient meet ≥ 75%. This means the instrument used in this study can measure the effects of learning. This because teachers in learning always refers to the lesson plan that has been prepared carefully and arranged systematically. This is supported by lesson plan validation data which indicated very high category.

Students Activity Observation

Student activity observation result can be summarized in Table 3 below. Average reliability calculation was 99.55%. It shows that instrument of observation of student activity used is reliable because the reliability coefficient meet ≥ 75%.

Processing Skill Improvement

Improved processing skills are shown in Table 4. The data in the table shows that the improvement of processsing kills is ≥ 0.7. This shows that the improvement of students' processing skills is in the high category. The average gain class is 0.84.

Table 4 shows that there is an improvement in processing skills (learning outcomes) of students before and after the learning process was done. It affirms that students processing skill is improved after being treated by pure cartoon media combined with guided inquiry model.

Material Mastery Test

The material mastery test was done twice (pretest) before the students begin the guided inquiry learning process and the final test (postes) conducted after the teaching activity using pure cartoon media combined with guided inquiry model. The following table demonstrates the credibility of Minimum Criteria of Masetery on Cognitive products and processes and their mean values.

DISCUSSION

Quality of Insructional Instrument and Trials

The instructional instrument developed in this research were guided inquiry oriented lesson plan, students activity sheets, pure cartoon media, and learning outcome tests. The results showed that the instructional instrument developed obtained the reliability as follows: Lesson Plans obtained 92.85%; Students Activity Sheets obtained 84.61%; Learning Outcome Tests obtained 82.35% for content aspect, 88.23% for construct validation; Media obtained 85.12%. According to the data analysis of quality of instructional instrument, it can be concluded that the the developed instructional instrument is good

Table 3. Students Activity in Learning

No	Student Activity	Students activity frequency (%) on meeting -			Average
		1	2	3	
1	Listening/paying attention to teacher or student	12,06	11,83	10,57	11,48
2	Discussion among students or with teacher	1,95	2,06	2,52	2,08
3	Group work for students activity sheet	52,64	19,88	19,97	30,38
4	Planning, conducting experiment, and observing	-	42,98	44,25	43,62
5	Discussing assignment	16,55	13,36	13,21	14,38
6	Presentation	16,20	9,54	9,31	11,68
7	Irrelevant behavior	0,6	0,34	0,17	0,37
Reliability		98,9	100	99,77	99,55

Table 4. Processing Skill Improvement

No	NIS	Nilai (%)		Gain
		Pretest	**Postest**	
1	9630	17,70	91.66	0,89
2	9636	14,58	89.53	0,87
3	9637	9,37	89.53	0,88
4	9648	10,41	91,66	0,90
5	9660	16,66	86.45	0,83
6	9590	12,50	91,66	0.90
7	9593	17,70	80,20	0,75
8	9600	19,79	84.37	0,80
9	9602	11,45	87,50	0,85
10	9603	13,54	80,20	0,84
11	9604	14,58	86.45	0,84
12	9605	12,50	86.45	0,84
13	9606	9,37	84.37	0,82
14	9607	19,79	88,54	0,85
15	9608	11,45	89.53	0,88
16	9616	14,58	80,20	0,76
17	9628	13,54	87,50	0,85
18	9635	19,79	91,66	0,89
19	9646	14,58	84.37	0,84
20	9652	11,45	86.45	0,84
	Average	14,26	86,56	0,84

and feasible to be used after complementing the revision from validators. Intense communication on educational experts were done to generate qualified instrument.

Trials on insructional instrument indicates that the learning accomplishment has been accomplished well and it is categorized as good. Generally, during trial I with the developed instructional instrument, the activity were student-centered learning. According to the observation, the most dominant activities are planning, conducting, experimenting, and observing.

Students responded very positively to the application of learning by using guided inquiry model with pure cartoon media. These responses include the topics being studied, Student Activity Sheet, instructional models, instructional media,

Tabel 5. Proses Accomplishment of Learning Outcomes Test on Cognitive Product and Process

No	Cognitive Product Pretest Average	Posttest average	Cognitive Process Pretest Average pretest	Posttest average
1	12,5	88,20	14,34	89,90

the way teachers teach and the learning atmosphere of the teacher trained; they responded well to the component; very interested in following teaching and learning activities; students felt that it is not difficult to answer the test of learning outcomes.

Students learning outcomes results on trial I which include cognitive learning outcome product and process through classical pretest was on unaccomplished category. After being treated by having pure cartoon media combined with guided inquiry model, students learning outcome in posttest accomplished.

Cognitive Learning Outcomes Results on Product, Process, and Improvement of Processing Skills

The cognitive learning outcomes of the students' products and processes are seen from the results obtained by the students during the final test. Based on the research data as shown in Tables 8 and 9, it is seen that before the learning process using the pure cartoon media with guided inquiry learning model, all students (100%) are in the unaccomplished category, both on cognitive product learning outcomes (pretest average = 12, 5) and cognitive processes (pretest average = 14,32). After the learning process using the pure cartoon media, student learning outcomes improved where almost all students were in accomplished category, reached 95% cognitive product learning outcomes (mean postest = 88.20) and cognitive learning outcomes were 100% (mean postest = 89.90). Meanwhile, the result of data analysis also shows that the improvement of students' processing skill is in the high gain category (≥ 0.7) with an average gain of 0.84, as shown in Table 4.

This is because the utilization of guided inquiry learning model can enable students to construct their own understanding through their participation in scientific activities related to the concepts or assigments being studied. In addition, the use of pure cartoon instructional media can make the learning becomes more meaningful since it translates abstract concepts into concrete one. This is supported by data analysis result of student response related to instructional media used. Table 7 shows that 90% of the students responded very interestingly to the pure cartoon media and as many as 96.5% of students responded interested in following such teaching activities for further Chemical topics or for other lessons.

Inquiry learning model is very suitable to be used in teaching science to students. Because the characteristics of learning science is not just generating a product (fact, law, theory, or concept) but also the process of how the product is found and the scientific attitude. As a part of science, Chemistry is very appropriate to be taught using the inquiry model. In this study, guided inquiry was used because the subject of research has not been familiar with inquiry activities.

Rudinillah (2011) states that students' science process skills are improved after being given instruction with inquiry approach. Zawadzki (2010), Brickman, et al (2009) state that guided inquiry models can be used to teach processing skills (higher-order thinking skills). The same thing is also conveyed by Derlina & Afrianty (2016), that the instructional model of inquiry with visual media can make students' processing skill becomes better than using conventional learning model.

CONCLUSION.

The results showed that the activity and the student's response were very positive towards Pure Cartoon media and guided inquiry learning model used in Chemistry learning process. The cognitive learning outcomes of the students' products and processes have met minimum criteria of mastery learning. The improvement of students' processing skills is in the high gain category. Therefore, it can be concluded that the developed media can improve processing skills and students' learning outcomes.

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